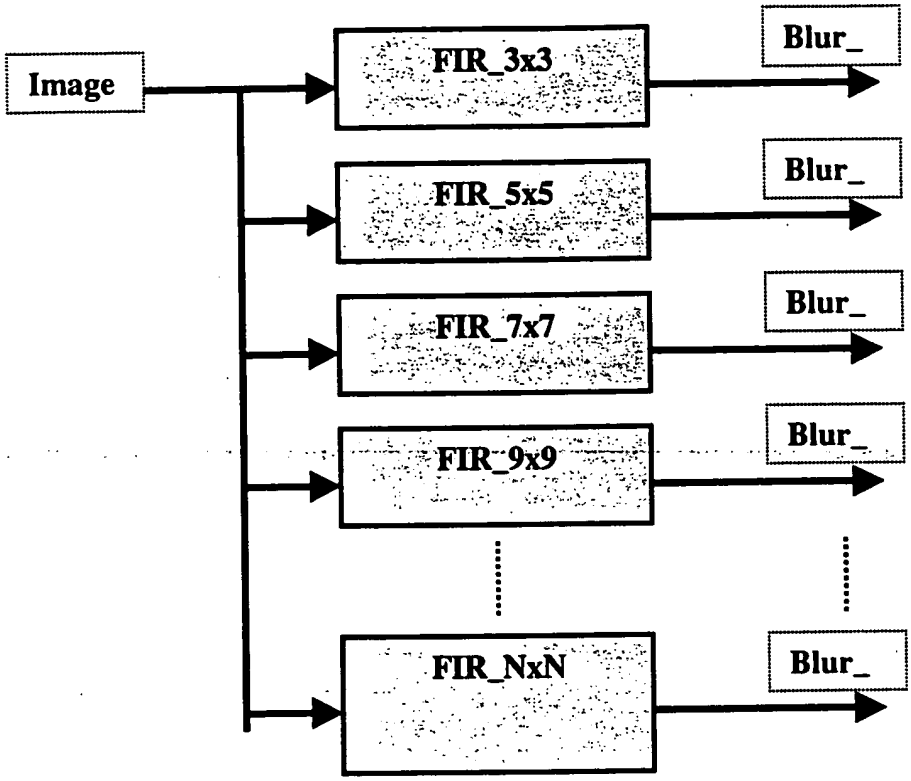
Image
FIR_3x3
FIR_5x5
FIR_7x7
FIR_9x9
FIR_NxN
Blur_
Blur_
Blur_
Blur_
Blur_

FIG. 1

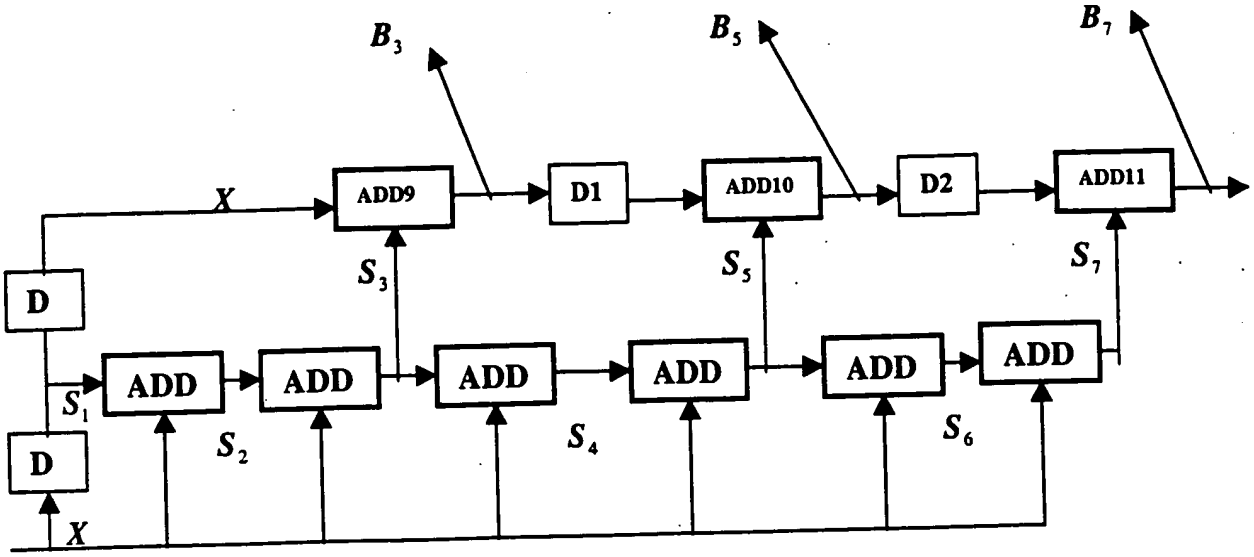
B_3
B_5
B_7
X
ADD9
D1
ADD10
D2
ADD11
S_3
S_5
S_7
D
ADD
ADD
ADD
ADD
ADD
ADD
S_1
S_2
S_4
S_6
D
X

FIG. 2

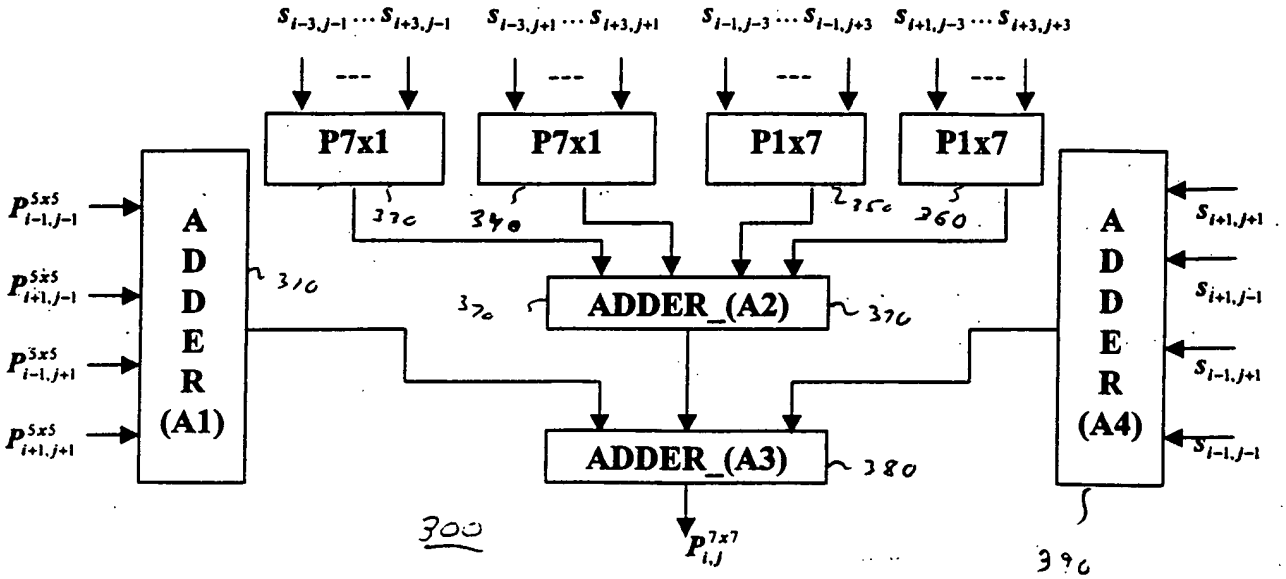
$S_{i-3,j-1} \cdots S_{i+3,j-1}$
$S_{i-3,j+1} \cdots S_{i+3,j+1}$
$S_{i-1,j-3} \cdots S_{i-1,j+3}$
$S_{i+1,j-3} \cdots S_{i+3,j+3}$
P7x1
P7x1
P1x7
P1x7
$P^{5x5}_{i-1,j-1}$
$P^{5x5}_{i+1,j-1}$
$P^{5x5}_{i-1,j+1}$
$P^{5x5}_{i+1,j+1}$
ADDER (A1)
310
370
340
350
360
ADDER_(A2)
370
ADDER_(A3)
380
300
$P^{7x7}_{i,j}$
ADDER (A4)
390
$S_{i+1,j+1}$
$S_{i+1,j-1}$
$S_{i-1,j+1}$
$S_{i-1,j-1}$

FIG. 3

FIG. 4

$$P^{kxk} = \begin{bmatrix} P_{0,0}^{kxk} & P_{0,1}^{kxk} & \cdots & P_{0,N-1}^{kxk} \\ P_{1,0}^{kxk} & P_{1,1}^{kxk} & \cdots & P_{1,N-1}^{kxk} \\ \vdots & \vdots & P_{i,j}^{kxk} & \vdots \\ P_{M-1,0}^{kxk} & P_{M-1,1}^{kxk} & \cdots & P_{M-1,N-1}^{kxk} \end{bmatrix}$$

FIG. 5

$$S = \begin{bmatrix} s_{0,0} & s_{0,1} & \cdot & \cdots & \cdot & \cdot & s_{0,N-1} \\ s_{1,0} & \cdot & \cdot & \cdot & \cdot & \cdot & s_{1,N-1} \\ \cdot & \cdot & s_{i-1,j-1} & s_{i-1,j} & s_{i-1,j+1} & \cdot & \cdot \\ \vdots & \cdot & s_{i,j-1} & s_{i,j} & s_{i,j+1} & \cdot & \vdots \\ \cdot & \cdot & s_{i+1,j-1} & s_{i+1,j} & s_{i+1,j+1} & \cdot & \cdot \\ \cdot & \cdot & \cdot & \cdot & \cdot & \cdot & \cdot \\ s_{M-1,0} & s_{M-1,1} & \cdot & \cdots & & \cdot & s_{M-1,N-1} \end{bmatrix}$$

$$F_{kxk} = \begin{bmatrix} 1 \\ 2 \\ 3 \\ \vdots \\ \frac{k-1}{2} \\ \vdots \\ 3 \\ 2 \\ 1 \end{bmatrix} * \begin{bmatrix} 1 & 2 & 3 & \cdots & \frac{k-1}{2} & 4 & 3 & 2 & 1 \end{bmatrix}$$

$$= \begin{bmatrix} 1 & 2 & 3 & \cdots & \frac{k-1}{2} & \cdots & 3 & 2 & 1 \\ 2 & 4 & 6 & \cdots & \frac{2(k-1)}{2} & \cdots & 6 & 4 & 2 \\ 3 & 6 & 9 & \cdots & \frac{3(k-1)}{2} & \cdots & 9 & 6 & 3 \\ \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots \\ \frac{k-1}{2} & \frac{2(k-1)}{2} & \frac{3(k-1)}{2} & \cdots & \frac{(k-1)*(k-1)}{4} & \cdots & \frac{3(k-1)}{2} & \frac{2(k-1)}{2} & \frac{k-1}{2} \\ \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots \\ 3 & 6 & 9 & \cdots & \frac{3(k-1)}{2} & \cdots & 9 & 6 & 3 \\ 2 & 4 & 6 & \cdots & \frac{2(k-1)}{2} & \cdots & 6 & 4 & 2 \\ 1 & 2 & 3 & \cdots & \frac{k-1}{2} & \cdots & 3 & 2 & 1 \end{bmatrix}$$

FIG. 6

$$F_{9x9} = \begin{bmatrix} 1 \\ 2 \\ 3 \\ 4 \\ 5 \\ 4 \\ 3 \\ 2 \\ 1 \end{bmatrix} * \begin{bmatrix} 1 & 2 & 3 & 4 & 5 & 4 & 3 & 2 & 1 \end{bmatrix} = \begin{bmatrix} 1 & 2 & 3 & 4 & 5 & 4 & 3 & 2 & 1 \\ 2 & 4 & 6 & 8 & 10 & 8 & 6 & 4 & 2 \\ 3 & 6 & 9 & 12 & 15 & 12 & 9 & 6 & 3 \\ 4 & 8 & 12 & 16 & 20 & 16 & 12 & 8 & 4 \\ 5 & 10 & 15 & 20 & 25 & 20 & 15 & 10 & 5 \\ 4 & 8 & 12 & 16 & 20 & 16 & 12 & 8 & 4 \\ 3 & 6 & 9 & 12 & 15 & 12 & 9 & 6 & 3 \\ 2 & 4 & 6 & 8 & 10 & 8 & 6 & 4 & 2 \\ 1 & 2 & 3 & 4 & 5 & 4 & 3 & 2 & 1 \end{bmatrix}$$

FIG. 7

$$P^{1xk} = \begin{bmatrix} P_{0,0}^{1xk} & P_{0,1}^{1xk} & \cdot & \cdots & \cdot & \cdot & P_{0,N-1}^{1xk} \\ P_{1,0}^{1xk} & P_{1,1}^{1xk} & \cdot & \cdot & \cdot & \cdot & P_{1,N-1}^{1xk} \\ \cdot & \cdot & \cdot & \cdot & \cdot & \cdot & \cdot \\ \vdots & & \cdot & P_{i,j}^{1xk} & \cdot & \cdot & \vdots \\ \cdot & \cdot & \cdot & \cdot & \cdot & \cdot & \cdot \\ \cdot & \cdot & \cdot & \cdot & \cdot & \cdot & \cdot \\ P_{M-1,0}^{1xk} & P_{M-1,1}^{1xk} & \cdot & \cdots & \cdot & \cdot & P_{M-1,N-1}^{1xk} \end{bmatrix}$$

FIG. 8

$$P^{kx1} = \begin{bmatrix} P_{0,0}^{kx1} & P_{0,1}^{kx1} & \cdot & \cdots & \cdot & P_{0,N-1}^{kx1} \\ P_{1,0}^{kx1} & P_{1,1}^{kx1} & \cdot & \cdot & \cdot & P_{1,N-1}^{kx1} \\ \cdot & \cdot & \cdot & \cdot & \cdot & \cdot \\ \vdots & \cdot & \cdot & P_{i,j}^{kx1} & \cdot & \vdots \\ \cdot & \cdot & \cdot & \cdot & \cdot & \cdot \\ \cdot & \cdot & \cdot & \cdot & \cdot & \cdot \\ P_{M-1,0}^{kx1} & P_{M-1,1}^{kx1} & \cdot & \cdots & \cdot & P_{M-1,N-1}^{kx1} \end{bmatrix}$$

FIG. 9